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COLONIES.

SUMMARY

OF

RESEARCHES ON NATIVE MALARIA AND MALARIAL
PROPHYLAXIS; ON BLACKWATER FEVER: ITS
NATURE AND PROPHYLAXIS.

BY

J. W. W. STEPHENS, M.D. Cantab., D.P.H.,

AND

S. R. CHRISTOPHERS, M.B., Vict., I.M.S.

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SUMMARY

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RESEARCHES ON NATIVE MALARIA AND MALARIAL PROPHYLAXIS; ON BLACKWATER FEVER; ITS NATURE AND PROPHYLAXIS.

BY

J. W. W. STEPHENS, M.D., Cantab., D.P.H., Lecturer in Tropical Medicine,
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I.

Of our researches on malaria those relating to native malaria seem to us of such great practical importance that in the present report we have almost entirely confined ourselves to a discussion of these, and their application to the prevention of malaria among Europeans in the tropics.

It is unnecessary here to discuss the question of the mosquito transmission of malaria. We may, however lay stress on some points which are as yet often overlooked:

1. It is practically certain that the mosquito cycle is the only one. We cannot, in the space at our disposal, give all the reasons for this statement; suffice it to say that up to the present no competent observer has brought forward a single fact inexplicable by mosquito transmission or suggesting any other channel of infection.

2. Regarding other hosts of the malarial parasite than man, no one has found any other animal than man infected with the organism of human malaria. The supposition that monkeys may be the means of infecting anopheles in the jungle is made highly improbable by Koch's researches. We may point out, too, that such a supposition is in no way needed to explain malaria contracted in the jungle, the real mode of infection in such conditions being now quite well understood.

3. All recent research confirms the view that malaria is always derived from malaria pre-existing in others.

It is as important to recognise that *malaria is only derived from man* as it is to appreciate that it is only transmitted by the mosquito (*Anopheles*). In other words malaria is as much an infectious disease as scarlet fever, the only difference being that it is not conveyed by contact, but only by the *Anopheles* mosquito.

Malaria then is an infectious disease—the infection or malaria parasite being conveyed from one person to another by the bite of *Anopheles*. An *Anopheles* mosquito, *per se*, is harmless; it is only an *Anopheles* containing parasites, or in other words an infected *Anopheles*, that can transmit malaria, and the only way by which an *Anopheles* can become infected is by “biting” some person who has the parasite in his or her blood.

It at first sight seems strange that the infective character of malaria has been and is still so overlooked by the general public. The actual mode of infection, however, has lately been made clear. Malaria is not in the tropics usually contracted from “fever” cases, but almost always from “latent” malaria in the native population.

Native Malaria.

1. Koch, in the East Indies, almost everywhere found malaria in the children though adults were free from infection. He commonly found malarial infection only on microscopical examination of the blood. In some of the villages examined by him every child had malaria, in others a smaller proportion. He came to the conclusion that the degree of infection he found in these children was a test of the intensity of malaria.

2. We ourselves, finding that *Anopheles* caught in native villages always contained a considerable percentage of infected specimens, were led to the discovery that this was dependent upon a general infection of the native children of Africa who, although apparently in good health, had almost always the malarial parasite in their blood. We were thus able to show that the home of malaria is in native huts, hamlets, villages, and towns, and that European malaria is a mere resulting sign of the vast degree of indigenous latent malaria.

This has been amply confirmed subsequently by other observers, notably by Annett and Dutton in Nigeria, Ziemann in the Cameroons, and again by ourselves in India.

The infection of Anopheles.

Where human infection is so general we should expect also to find *Anopheles* infected, and, indeed, in any batch of *Anopheles* caught in native huts a greater or less proportion always contain sporozoites, *i.e.*, the malarial parasite in a condition ready for infecting man. The number of *Anopheles* infected is a

variable one. As a rule in Africa it is from 5 per cent. to 10 per cent., but reached in some villages 50 per cent. Aro, on the Lagos railway, was an instance where the sporozoit rate in *Anopheles* caught in native huts was 50 per cent. Obviously it would be as difficult to avoid malaria in such a place as small-pox in a small-pox hospital.

We have said before that *Anopheles* are only capable of giving rise to malaria when they have previously fed upon blood containing malarial parasites, but a curious fact, and one of great importance, may be here noted. *Anopheles* are mainly to be found in association with native dwellings. One has not long to do with *Anopheles* without finding that they are hardly ever really abundant, except in native communities. Whenever in any place we wished to collect large numbers, our invariable practice was to proceed to the native quarter, and there we could collect *Anopheles* generally without difficulty. It was otherwise elsewhere, and in remote marshes occasional specimens (most frequently of a "wild" species) only were caught in our tents. So far as appears at present, the majority of *Anopheles* in Africa haunt native villages. It is, perhaps, almost permissible to say that about 5 per cent. of all the *Anopheles* of tropical Africa are infected with malaria and infected solely because they have derived the infection from latent native malaria.

In nearly every hut, then, of the millions scattered over the jungle lands of Africa, and of those forming the densely crowded towns of West Africa, we have children with parasites in their blood, and *Anopheles* to disseminate these.

The consequent infection of Europeans.

The condition of extreme unhealthiness found *par excellence*, in West Africa is not determined by the "climate." The reason is largely to be found in the conditions under which Europeans at present live in Africa. Even on general grounds it would be well to avoid native huts and hovels, with all their dirt and insanitary surroundings, conditions which may be likened to those in the worst slums of our large towns. When, however, we realise that these huts are veritable hotbeds of malaria, it is evident that the very first sanitary law for Europeans in Africa is to avoid their neighbourhood. It is, however, a striking, but most deplorable, feature that in Africa hardly ever do we find a European bungalow or dwelling place built with this end in view. European houses are often situated among the huts of the natives in towns, as in Freetown, Sierra Leone, or they have a cluster of hovels or huts close at hand. In one instance we saw a new settlement being built on the very fringe of a native village. It was not a question of necessity, as land free from villages or huts was available all around,

nor was there any reason of policy, the Europeans being employed on the railway, and having no relation with the villagers. The choice of such a site sufficient in itself to ensure the settlement being a very deadly one, as it indeed was later the case, could only be deplored. To sum up, then, we can say that with certain notable exceptions, to be mentioned later, the European on the West Coast of Africa is living in the midst of native huts and is consequently daily exposed to the bites of infected *Anopheles*. The actual conditions are described in greater detail in the following section dealing with prophylaxis.

PROPHYLAXIS.

At the outset we shall divide the prophylaxis of malaria under two heads:—

1. The prevention of malaria in native communities.
2. The prevention of malaria in Europeans.

The two problems are essentially different, and no confusion should ever exist in our minds as to what any given anti-malarial measures are intended to achieve, whether increased health of resident Europeans or diminution of native malaria.

1.—*The prevention of malaria in native communities.*

Prophylactic measures applicable to the average native of tropical Africa are, for many years to come, beyond discussion. The vast bulk of African natives are completely beyond any sanitary control whatever. In some large towns a measure of control does exist, *e.g.*, Freetown, Lagos, Accra, Cape Coast Castle and a few others. In these only has one the least hope of achieving any result.

Methods of malarial prevention applicable to large native communities seem confined to some form of *Anopheles* destruction, either by superficial drainage or by the continuous labours of a mosquito brigade. The administration of quinine, advocated by Koch, though so effective under the conditions at Stephansort, could not, we feel certain, be applied with any measure of success even in Freetown or Lagos. Speaking briefly we, ourselves, do not believe that with the means at the disposal of the sanitary bodies in West Africa any appreciable diminution in native malaria can at present be brought about. The destruction of *Anopheles* larvæ was, at first sight, so effective a means of getting rid of malaria that schemes for extensive destruction had many advocates. In our own experience the outlook has become less hopeful the more the habits of *Anopheles* have become known, and our opinion of the practicability of such operations has become gradually subverted by the practical experience of the difficulty of undertaking effective measures on a large scale. If drainage can be efficiently carried out over a particular area, it would, we

believe, be successful in diminishing native malaria, but the conditions surrounding each case must determine to what extent such measures can be applied.

2.—*The prevention of malaria in Europeans.*

In 1900, working on the Gold Coast, we advocated the protection of Europeans in Africa as being at present the proper and legitimate object of our limited resources in Africa. We gave reasons for believing that a system of segregation from the native, carried out as opportunity offered, would be far more effective than any other prophylactic measure within our power. We have already seen that the malarial fever to which the European is subject is due to the fact that he lives amidst the natives, or with the native at his door. We would emphasize again the fact that these conditions have impressed themselves upon us so vividly, because our experience of them has not been that of a passing observation, but one derived from actually living under them. We have enjoyed the hospitality of very many Europeans, and have slept in the bungalows and quarters of officials, railway engineers, missionaries, settlers, traders, in quarters in the centre of native camps, always with the inevitable native huts in the compound, and in all, these conditions held good. Realising the danger of sleeping under such conditions we succeeded in preserving our health only by most constant and unremitting care in the use of personal precautions. Such precautions we, however, found were generally so irksome that men preferred to run the risk of infection rather than bestow the necessary attention to them. Although we used mosquito nets we found it necessary to employ an extraordinary and troublesome degree of care in their use in such conditions as are usual in African up-country stations, and we believe but few men would employ them with sufficient care to avoid infection in such places. Similarly with regard to houses protected with wire gauze. Even where the oppressiveness of the climate would not preclude their use, we consider that it is only by a constant vigilance that but few men would exercise, that such measures could be successful.

As a preliminary step to all other prophylactic measures, and as one likely more than any other to minimise European malaria we, therefore, advocate "Segregation from the Native."

Since we first put forward segregation as a principle to be followed whenever opportunity offered, it has been recognised by some authorities* as the first law of hygiene in the tropics; on the other hand it has met with criticism. Much of the latter is evidently based on mistaken notions of what is meant by segregation, and what segregation entails. Segregation as an anti-malarial measure does not, for instance, mean the

* NOTE.—Manson. Practitioner, 1900. Annett and Dutton, 2nd Expedition, Liverpool School.

avoidance of intercourse with the native. Nor does it mean a lessening of the power of control of the native. It has been said that segregation means giving up a country. Such a notion could only arise from a complete misconception of what is meant by segregation in this connection. The fact that in India segregation is almost universal seems to us to effectively meet such objections. In India we do not, except rarely, find Europeans dwellings and native quarters crowded together, but almost always a well-designed European quarter, quite distinct from the native bazaar. Yet in India there can be no question of loss of touch with the natives—rather on the contrary, an increased respect on their part.

To talk also of the impossibility or impracticability of segregation in Africa is absurd, because a most excellently carried out scheme of segregation already exists at Accra (Victoriaborg), and to a less extent at Old Calabar, both which places are noted on the West Coast for their comparative healthiness. Moreover, since we first advocated such measures they have been advocated also by Annett and Dutton (2nd Liverpool Expedition) as applicable, above any others, to Nigeria. These authors had actual experience, during many months, of the condition under which the European lives, and they advocate segregation as strongly as we do ourselves.

Further, Logan Taylor, himself engaged in destructive measures against mosquitoes, says* “When suitable ground can be had I think it better for the European to live away from the native town. In Accra the Government officials have good bungalows away from the native town, forming a proper European quarter (Victoriaborg), and this arrangement is found to work well, and Accra is the healthiest town on the Gold Coast.”†

PRACTICAL APPLICATION OF SEGREGATION TO VARIOUS CONDITIONS OF LIFE IN TROPICAL AFRICA.

Since we feel very strongly that the segregation of Europeans is the first step in the prophylaxis of malaria in Africa and other tropical regions, we think it desirable to show how in practically every condition of life this principle can be applied.

So far prophylaxis (destructive measures) has been directed entirely against the malaria of large towns. If even, however,

* NOTE.—Second Progress Report of the Campaign against Mosquitoes in Sierra Leone. Liverpool University Press.

† NOTE.—That segregation is a practical measure there is increasing evidence to shew. Thus at Akassa (Nigeria) “a hotbed of fever and disease,” segregation has been effected (together with drainage and the regular administration of quinine to Europeans), and Akassa is now one of the healthiest stations in West Africa. (Brit. Med. Jour., April 18, 1903, p. 924.) Further segregation schemes have been carried out at Secondee and Cape Coast Castle.

we could make the large towns of West Africa healthy we should still have an enormous fever and death rate among Europeans on the Coast, quite half of whom live in out-stations, and the great majority of whom make very frequent tours. Moreover, it is in *out-stations* that Europeans are chiefly in need of protection. Whereas we found that residents in towns enjoyed, on the whole, fair health, it was in out-stations that we chiefly found men in the fever-stricken and miserable condition so characteristic of tropical Africa. We would point out then that something more than anti-malarial measures in large towns is needed if much improvement in the health of Europeans is to result.

It is here that "segregation" holds out such prospects of success. Not only is the formation of a European quarter in large towns a fundamental law of health, but, as we show, in out-stations, railway camps, mission stations, in bungalows, in tea or coffee gardens, in expeditions, military or otherwise, in ordinary travelling, segregation is equally applicable.

Before malaria is made to decrease among Europeans in Africa it must be generally recognised that malaria is an infectious disease, and that it is present in practically every native hut. When this is the case men will refuse to allow in their compounds squalid grass and palm leaf huts; they will cease to build their bungalows among or on the outskirts of villages; they will be extremely careful where they sleep when travelling, and it will be the duty of the medical officers of mining camps, railways, and military expeditions to absolutely forbid the forming of any camps near native huts, or to allow these to spring up in the more permanent camps.

1.—*Segregation in large towns.*

We have two noteworthy instances where in large towns segregation has been carried out most effectively, with the result that the two segregated communities, Accra (Victoriaborg), and Old Calabar, are notoriously the most healthy on the coast.

Moreover, in any large town where such complete segregation on a large scale is not immediately applicable the principle should be borne in mind, and as opportunity offers, huts should be removed and European houses built in the open. Thus, at Lagos, a well-designed quarter could, we feel sure, be gradually formed, and would place Lagos in the same category as Accra. At Freetown, we believe arrangements are now being made to remove the official quarters to a segregated site on the hills,* and at Cape Coast Castle also a site for officials has been chosen, well removed from the native town. The plan

* NOTE.—Proposed site for European residences in the Sierra Leone hills. Stephens and Christophers. 5th Report to Malaria Committee, Royal Society.

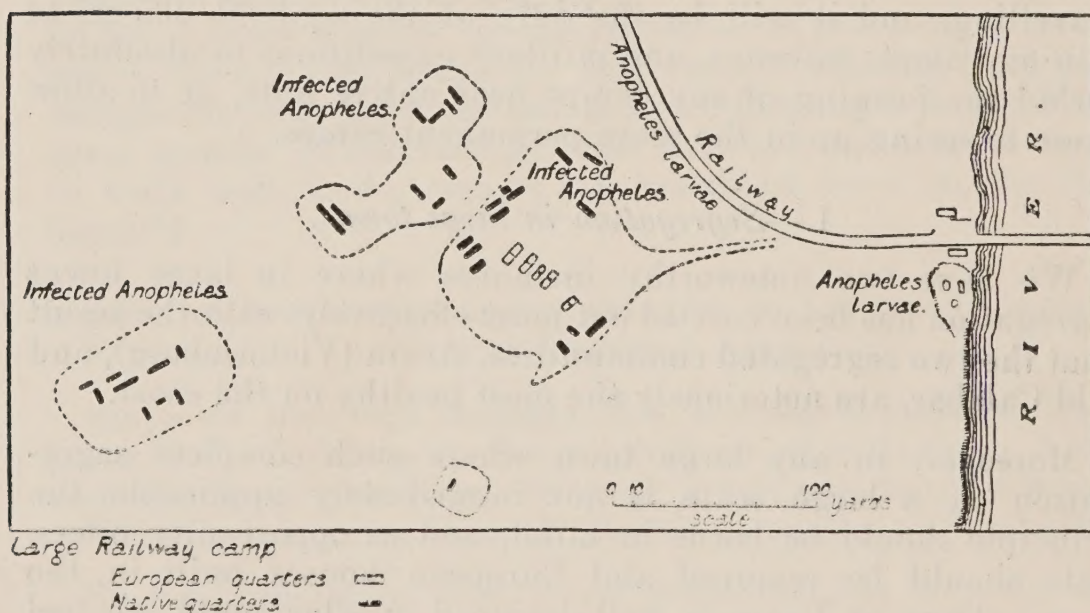
then to be followed in towns is the formation of a European quarter as distant as possible from native huts, and no better examples of this can be found than the arrangement in India of a European Cantonment and native bazaar.

2.—Segregation in out-stations.

The terrible sickness and mortality resulting from the practice of the European living amidst native huts was nowhere more forcibly brought to our notice than in the camps of engineers and other employés engaged on railways under construction. Every settlement and every camp showed the same most deadly practice of allowing numerous native huts to be erected actually in the compound, in which dwelt camp followers and their numerous families (children). To this fact alone is due the excessive sickness from malaria, and as a consequence also blackwater fever, on railways under construction. The working in swamps, and the turning up of soil are in no way responsible, and a single instance will suffice to show to what railway engineers owe the malaria they so markedly suffer from, for never did we succeed in finding an exception to this deadly arrangement of native huts (with their constant fever supply), and European dwellings close at hand.

The Lokomeji Camp on the Lagos Railway: (see plan).

PLAN OF LOKOMEJI.



About half a dozen Europeans lived in this enclosure. In it there were no less than 13 native huts, with, at a guess, 100 inhabitants, men, women, and children.

This is more than enough to explain the constant sickness among Europeans here, but in addition there is a second crowded native compound, and a third within one hundred yards. When we consider that every one of these huts is a source of malaria

(for actually one half of the *Anopheles* caught by us contained parasites in the stage ready for transmission to man), it becomes at once evident that a most unfortunate and disastrous mistake has been made by the Europeans living here. In such a case as this the engineer in charge of the section has the power of selecting a site, and has absolute power to forbid the building of any huts within any distance he chooses. When the European fully understands the certain danger to his health in living under such conditions, he will absolutely refuse to submit to such unnecessary exposure to danger. With ease, on a railway, a well segregated site for Europeans can always be provided. We shall see that a quarter to half a mile is ample, and some protection is ensured often by only a few hundred yards.

We have given a railway camp as an example of the evil effects of living amidst native huts because here, perhaps, most markedly did we see the result in the fever-stricken, anæmic Europeans subject more than any to blackwater fever. The condition of life is, however, equally typical of *all out-stations*, the planter, missionary, trader and even Government officials live universally under similar, though usually less deadly, conditions. In many such out-stations the condition could be remedied by very slight changes, the removal of a few hovels: often a single grass hut has been the source of perpetual fever among the Europeans living in a house.

We do not say that no native servant should sleep in a compound (though personally we found no inconvenience in allowing our servants to sleep away) for it is not in the presence of one or two adult servants that the danger lies, but in the numerous families (with children) crowded into dark and dirty huts so universally seen at the European's door. Once the fact is recognised that it is from the crowded cooly lines and native quarters that the European derives his fever, we feel sure that the whole hygienic aspect of these fever camps will change.

Segregation on Military and other Expeditions, and for Travellers and Sportsmen.

The facts already put forward explain also why military expeditions in Africa are attended with such a large amount of sickness and so terrible a mortality. As an example of the mode of contracting malaria on military expeditions we may instance Prahsu, a well-known halting place on the way to Kumasi from the Coast. It is probable that every man passing up or down to the Coast during the Ashanti campaigns slept at least a night at this station. From plans of the condition there, European quarters and native huts in close proximity, it is at once evident that here at least was one of the sources of the sickness and mortality among European troops, and not in the "climate."

In native villages the native porters are able to procure food, and here generally a clearing is found ready for a camp. So that it is the almost invariable practice of travellers of all kinds to camp in the village clearing, often to sleep in the native huts.

Here, again, we find the inevitable result. Although the traveller may not pay much attention to their bites, the *Anopheles* from the huts have injected malaria parasites (sporozoites) into his blood, and ten days later he is "down with fever."

Here, briefly, though it is a most important practical point, we must consider the question of flight of *Anopheles*. As the result of very numerous observations and experiments both in Africa and India, we may emphatically state that *Anopheles* do not often fly a quarter of a mile, and practically never half a mile. We are considering, it must be understood, the habitual, not the possible maximum, flight. *Anopheles* in fact tend to leave but for a short distance the thatched huts in which they spend the day, and although we give a quarter of a mile as a maximum flight, yet a segregation of 100 yards from a native hut is infinitely better than none at all. Also, every natural obstacle tends to aid segregation, and should be taken advantage of, as the ridge of a hill, a belt of trees, bananas, bamboos, &c., and though a well isolated dwelling, with no native families within a quarter or half a mile, should be aimed at, yet when native huts exist which it is impossible to remove, they should be as completely screened as possible by the planting of bananas, &c.

To sum up these various conditions we may say that a European who pitches his camp or builds his permanent quarters half a mile, to take an extreme limit, from any collection of native huts, however small, will avoid infection otherwise almost inevitable, and if in his compound he allows only those servants absolutely necessary, he is in a position to escape the dangers of life in tropical Africa.

PERSONAL PRECAUTIONS.

We cannot emphasize finally too strongly the need at present for these. We, ourselves, by unremitting care, completely escaped contracting malaria during over three years' residence in Africa and India; in places, too, where, more frequently than not, the deadly conditions we have described existed. Among these precautions we place the proper use of a mosquito net as by far and away the greatest means of individual protection.

1. *Mosquito net*.—The net should be square (not a bell net), should not have a single, even minute, hole, should hang inside the poles if these are used, should be tucked in *under* the mattress, and should *not* trail on the ground. A piece of closely

woven material, fastened on all round at the level of the body is a necessary addition, in order to protect the limbs during sleep from bites *through* the net. When not in use the ends of the net should be twisted up somewhat, and then thrown over the top. We always arranged our nets ourselves, never trusting to servants, and further, to be doubly certain, we always carefully searched the interior with a candle before going to sleep. To these minute precautions, solely, we attribute our absolute freedom from malaria. Employed without care and attention, a mosquito net is little protection in such malarious places as most up-country African stations.

2. *Subsidiary measures.*—In many of the more malarious places we visited we considered that other subsidiary precautions, such as will suggest themselves to any intelligent person, were also necessary. To protect our legs and ankles, for instance, we considered it necessary to wear thick trousers, with puttees, or the very convenient so-called mosquito boots. The face and hands are not in waking hours very likely to be bitten by *Anopheles*, though they are very likely to be bitten by various species of *Culex*. It must be understood, however, that for precautions to be effective in badly malarious places considerable care and thoughtfulness is entailed, and few followed our example.

3. *Quinine.*—During the whole of our three years' life in the tropics we found it quite unnecessary to use quinine. If, however, the bites of *Anopheles* cannot be guarded against quinine should be taken as a prophylactic. We consider Professor Koch's method of taking 15 grains on two successive days in each week as the best. Repeated small doses are of doubtful efficacy.

II.—BLACKWATER FEVER.

Considering the fatality of this disease, and the fear it inspires in the European in Africa, we fully realised the importance of trying to solve the vexed question of its cause.

We believe that facts observed by us based on direct microscopical evidence have placed on an absolutely satisfactory footing its malarial nature. The importance of this has a great added value, because it follows that the prophylaxis is identical with that of malaria, and the European who can protect himself from attacks of malaria will have no fear of contracting blackwater fever.

It has been held by the majority of competent observers in recent years in the tropics, notably A. and F. Plehn and Ziemann, that blackwater fever was malarial in nature. The most important objection to this view is that a microscopical examination of the blood in blackwater cases is generally

negative, *i.e.*, shows no malarial parasites, or so few as to make it doubtful if they could be associated with the attack. This, then, was practically the state of our knowledge when we commenced our work on this fever.

In our investigations into the ordinary forms of malaria, however, in the tropics, we soon recognised that in severe malaria also an examination of the blood might, in certain cases, reveal no parasites, or in other cases very few, quite insufficient apparently to account for the severe symptoms. Such cases were those in which quinine had previously been taken, so that it was not an uncommon experience for a blood examination to show, before the taking of quinine, numerous parasites, whereas later, while still high fever and severe symptoms continued, parasites might be entirely absent. Nor was it exclusively in cases where quinine had previously been taken that parasites were absent. In certain cases, though we believe these are comparatively rare, parasites may be absent, or if present, are so few in number that they bear no proportion to the severity of the attack. And, indeed, our experience has been confirmed by others working both in the tropics and in Europe by Celli, Ziemann, Schaudin.* Thus the last named says, in case I., parasites were present during the attack and during the intervals of the fever, but in case II. they were almost always absent on the day after the attack and during the attack they were very scanty, although the fever was extraordinarily severe.

We were led then, in such cases as these, to seek for other proofs of the malarial origin of the fever. Two such methods were adopted by us: the first consisted in a thorough search in extensive blood films for pigmented leucocytes, which are evidence of a recent attack of malaria. The second was by a determination of the relative proportion of the different varieties of leucocytes in the blood. We followed out this line of observation at length, and found that in malaria a relative increase of the large mononuclear leucocytes took place, and were led to consider a value as high as 20 per cent. as evidence of an antecedent malarial attack. Similar observations had also led Türk, whose work was then unknown to us, to point out the diagnostic value of this increase in the diagnosis of malaria. We have, then, two auxiliary methods in the diagnosis of malaria:—

1. The detection of pigmented leucocytes.
2. The increase in the percentage of the large mononuclear leucocytes.

Applying these subsidiary tests to blackwater fever in which parasites are, as a rule, absent, we were able to show that nearly all of these cases, apparently non-malarial, are, in fact, malarial,

* Arbeiten, a. d. k. Gesundheitsamte, s. 234, Bd. xix.

presenting pigmented leucocytes and an increase in the large mononuclear leucocytes. In our first series of 16 cases, although only in 3 were parasites found (about 19 per cent.), yet using these subsidiary tests no less than 93·7 per cent. were shown to be malarial.

We thus, as the result of our work, established on a microscopical basis, the proof of what had been previously mainly conjecture.

Blackwater fever, then, is malarial in origin. It cannot, however, be considered as simply a severe form of malarial fever, for there is yet another side to the question.

In 1860 Tomaselli first published a series of cases in which symptoms of blackwater fever followed upon the administration of quinine, not necessarily in large doses, but almost invariably in those who had suffered much from malaria.

A. Plehn and F. Plehn, in the Cameroons, have published most accurate histories of very many cases of blackwater, and with very rare exceptions they always followed upon the administration of quinine.

Koch has so strongly advocated the quinine factor in blackwater that it appeared at first as if he denied its malarial origin, but this is not so, as is quite clear from his later writings. He holds that quinine is the immediate exciting cause, but that a predisposition, determined by many attacks of malaria, is necessary.

Many of those who hesitated to give their assent to these views now acknowledge that there is such a thing as quinine haemoglobinuria occurring in malaria cases. This acknowledgment amounts to a recognition of the quinine origin of blackwater fever, for the two conditions are absolutely indistinguishable. We have ourselves seen cases which were to us clearly of this nature, and our views are summed up by saying that blackwater fever is a disease malarial in origin, and dependent on blood changes occurring after many malarial attacks, and generally, if not always, in relation to an actual attack, but that also it is undoubtedly almost invariably induced by the taking of quinine in this state.

It has been argued that if quinine is the cause of blackwater fever it is a dangerous drug, and should not be used in malaria, but this argument is not a good one. It is as we believe in the malarial chronic that blackwater almost always occurs. We believe that in such a person quinine is dangerous. If, however, quinine is efficiently used as a preventive of malaria no fear need be held of it. It is inadequate quinine treatment, because malaria is thereby not really combated, which is the danger.

While then we consider that the malarial origin of blackwater fever has been established by us on a basis of microscopical evidence, yet we may briefly consider some other aspects of the question, as it will enable us to answer some of the objections of a purely general character, which have hitherto been raised against its malarial origin.

1. It has been urged that the distribution of blackwater fever and malaria is not the same. Even if this statement were true it must not be forgotten that the distribution of mild malaria and severe malaria is by no means the same. Thus, the mortality from malaria in the few still remaining foci in Northern Europe is in no way comparable to that of the Roman Campagna, nor, again, is the severity of malaria in Northern Italy comparable with that in the South. We cannot, indeed, speak of the distribution of malaria as a whole. If, however, we confine our remarks to regions of intense malaria we believe that the distribution of blackwater fever will be found to tally exceedingly closely with that of malaria. The distribution of blackwater fever is, we believe, considerably wider than is generally supposed. Thus in the Bengal Duars, in India, blackwater was found by us to be as common as in Africa, a fact to which the literature of the distribution of blackwater fever gave us no clue.

Further, in Madras we discovered the existence of blackwater fever, the existence of which was quite unknown, even to medical men in India. We believe, in fact, that there is rather a very close and even exact parallel between the distribution of blackwater fever and severe malaria.

2. An accurate history of blackwater fever cases will always reveal that the patient has suffered more or less constantly from previous attacks of fever, and that for a day or two previous to his attack he has had a more or less markedly high temperature. That this temperature is of malarial origin is shown by microscopical evidence, for,

3. If the blood of a patient about to suffer from blackwater fever is examined by chance before the onset of the disease, and before the taking of quinine, it is almost invariably the case that malarial parasites are easily found. An examination of the same case after the onset of the blackwater is, however, most frequently negative as regards parasites. Thus Panse, in a recent paper (*Zeitschrift für Hygiene*, s. i. 1903) found parasites without exception in all those cases which he was able to examine immediately before the onset of the haemoglobinuria; and arrives at exactly the same conclusion as ourselves as to the direct dependence of blackwater on malarial infection.

4. That blackwater fever affects residents mainly in their second and third year suggests that it occurs in conditions of

chronic malarial infection, and is strongly against a view which has been suggested that blackwater fever is due to a special parasite. Thus Berenger-Féraud* gives the following data, 1st year, 5·4 per cent., 2nd year, 22·5 per cent., 3rd year, 42·5 per cent., 4th year, 20 per cent., 5th year, 4·8 per cent.

5. Again, the fact that in West Africa and other regions where blackwater fever occurs Europeans die not so much of malaria but of blackwater fever, seems to admit only of one conclusion. To give more exact figures it appears that in the German Colonial possessions out of 3,000 cases of malaria there were 8 deaths only from ordinary malaria, but 62 from blackwater fever. However we consider these general points they all clearly point to the malarial origin of blackwater fever, though, as we have said, the real evidence depends upon the microscopical evidence of malaria in blackwater.

Blackwater fever, then, is malarial in its nature, and its prophylaxis is consequently identical with that of malaria.

J. W. W. STEPHENS,
M.D., Cantab.

S. R. CHRISTOPHERS,
M.B. Vict., I.M.S.

February 4, 1903.

* "La Fièvre Bilieuse Melanurique."



The following table shows the results of the investigation into the matter of the alleged fraud in the case of the late Mr. J. H. P. & Co. Ltd. The results are given in the following table.

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